
AQUAPONIC
GARDENING
A BEGINNER'S GUIDE TO RAISING
VEGETABLES AND FISH AT HOME
LOUIS MURPHY

AQUAPONIC GARDENING

A Beginner's Guide to Raising Vegetables and Fish at Home

Table of Contents

Legal & Disclaimer

The information contained in this book and its contents is not designed to replace or take the place of any form of medical or professional advice; and is not meant to replace the need for independent medical, financial, legal or other professional advice or services, as may be required. The content and information in this book has been provided for educational and entertainment purposes only.

The content and information contained in this book has been compiled from sources deemed reliable, and it is accurate to the best of the Author's knowledge, information and belief. However, the Author cannot guarantee its accuracy and validity and cannot be held liable for any errors and/or omissions. Further, changes are periodically made to this book as and when needed. Where appropriate and/or necessary, you must consult a professional (including but not limited to your doctor, attorney, financial advisor or such other professional advisor) before using any of the suggested remedies, techniques, or information in this book.

Upon using the contents and information contained in this book, you agree to hold harmless the Author from and against any damages, costs, and expenses, including any legal fees potentially resulting from the application of any of the information provided by this book. This disclaimer applies to any loss, damages or injury caused by the use and application, whether directly or indirectly, of any advice or information presented, whether for breach of contract, tort, negligence, personal injury, criminal intent, or under any other cause of action.

You agree to accept all risks of using the information presented inside this book.

You agree that by continuing to read this book, where appropriate and/or necessary, you shall consult a professional (including but not limited to your doctor, attorney, or financial advisor or such other advisor as needed) before using any of the suggested remedies, techniques, or information in this book.

Introduction

The term Aquaponics initially originated during the Cold-war era in America. During this period, a-bomb scare forced most people to think of a combination of aquaculture- raising fish for personal consumption and hydroponics- soilless plant production.

Extensive research was later carried out on the system, and it was discovered that the agricultural growing system is, in fact, a form of symbiotic system. Which is between the plant, fish, and bacteria. And it only requires a small space. The fish helps to provide fertilizer for the plant and also controls insects.

Aquaponics is the technique of using farm fish or other marine life to supply nutrients to plants that are grown using a hydroponics system.

This means that instead of adding nutrients to the water as you would in a hydroponics system, you would instead rely on the waste from the fish or other marine life to add the nutrients to the food.

Even though both of these systems are great ways to grow plants as well as fish when we look at combining the two systems the problems within each system become a positive in the new system.

What happens when you combine both systems are that you get a system that enables you to grow both plants and fish without having to do a lot of water changes and without having to dispose of nutrient rich water. You also will find that you do not have to spend a lot of money on nutrients to place in your water.

The way it works is that the plants are able to extract the water that they need and the growing medium cleans the water for the fish, the bacteria that grows on the medium converts the ammonia waste from the fish into nitrates that are in turn used by the plants.

There are many different mediums you can use and although some require that you do remove some of the water each day you will be able to recycle the water and use it to water your garden or other plants around your yard.

You should also know that you can grow may differently types of fish in your aquaponics system but you need to make sure you check with state regulations first as it is illegal to grow some fish in certain areas.

Studies have shown that using an aquaponics system actually uses 10 percent of the water that it would normally take to grow a garden so even though you may end up having to change your water frequently you will actually be using less water than if you were growing a traditional garden.

Aquaponics can also be extremely productive producing a large amount of fish to eat as well as a large number of crops in a small area. The system requires no bending, weeding or fertilizing and if it is placed outdoors it will require very little energy to run.

One of the great benefits of aquaponics is that it saves space. When you use aquaponics, you are able to grow your closer together because they always have access to the nutrient rich water. This means that they will not need large root systems like they would if you were to use traditional gardening techniques which in turn means that you can keep your plants close together. Another benefit of aquaponics is that you do not have to worry about weeding your garden.

In this book, you will learn the various techniques that will enable you to produce a whole meal in a compact and straightforward unit or system. It allows you to grow plants and animals in an environmentally sustainable system, which creates a self-sustaining ecosystem in a small home scale.

So, get set to take advantage of this opportunity to maximize your space, money, and effort most productively.

Chapter 1: Aquaponics Gardening

The process of aquaponics starts with a water tank containing live fish which are fed as often as needed or recommended. The water from the fish tank is then periodically directed to the vegetable growing beds. The water then filters through the plants that are growing and drains slowly from the bottom of the growing beds and is re-directed to the fish tanks.

This works so well because the water from the fish tank contains bacteria from fish waste products combined with uneaten fish food which supplies the growing plants with the nutrients they need in order to grow well. As the fish tank water drains through the growing plants, it is purified and oxygenated and then returned to the fish holding tanks. This oxygen-rich water is needed for optimal fish growth which in turn produces more nutrient-filled water for the plants and the cycle continues indefinitely.

Basic Components

There are 2 major parts of a typical aquaponics setup: the aquaculture portion, where you will be raising the fish or other aquatic animals such as shrimp and crayfish, and the hydroponics where the plants are grown.

The entire system is closed. That is, the water is circulated and recirculated between the aquaculture and hydroponics parts. Effluents or wastes accumulate in the aquatic tank, which comes from left over feed and animal waste. This build up creates a toxic environment for the aquatic animals. This is where the hydroponics setup comes in handy. The “dirty” water is brought up to the hydroponics setup. The effluents are toxic to the animals, but are much needed nutrients for the plants.

All aquaponics systems are composed of these 2 main parts, but are often grouped further into subsystems. These subsystems or components function for solid waste removal, maintain water oxygenation or for neutralizing pH. Typically, components are the following:

•Rearing tank

The rearing tank is any large container where the fish and other aquatic animals will live.

•Settling basin

This unit is responsible for catching any leftover feed and any detached biofilm. It is also used as a receptacle where fine particulates are allowed to settle.

•Biofilter

This component holds the bacteria responsible for the nitrification process. The biofilter unit is where bacteria convert the ammonia from the fish wastes into nitrates that the plants use for nourishment.

•Hydroponics subsystem

This is where the plants are. The main function of the hydroponics subsystem is to act as a filtering system that removes nitrates from the water and returns the clean and fresh water back into the rest of the system.

•Sump

This is the lowest point of the entire aquaponics system. Water flows into the sump from the hydroponics, already clean. It is then pumped out and brought back into the rearing tank.

How It Works

Aquaponic gardening is water-based, not soil-based. It incorporates a built-in source of fertilizing. It's a perfect world where weeding never happens. Your garden is a delight for the eyes, and you do it all with little daily effort.

A key factor is its sustainability. An aquaponic garden is meant to function on its own with a minimal amount of effort. It takes a little information and some work to set it up, a little time to create that lovely nutrient-laden water, but it's all part of the joy in building your very own masterpiece of fish and produce, meshed together in a mutually beneficial ecosystem.

How It Differs from Other Forms of Gardening / Agriculture and More

You probably don't need much convincing to believe that aquaponics is a better system for the environment. It can produce more food at a faster rate than traditional farming with a fraction of the water.

But these are not the only benefits. In fact, they are simply the biggest benefits to commercial farmers. Here are some more benefits when you use aquaponics:

Reduced disease

One of the biggest threats to most plants is the pests that live in the soil. They can attack the roots or simply deprive them of the nutrients they need. they can even cause death to one plant or kill a huge number of plants in one fell swoop. That's why agriculture uses pesticides to prevent it.

There is much less risk of this happening in an aquaponics system. There is no soil and, therefore, no soil-based pests. There are still pests in an aquaponics system, but significantly less than there are in soil-based production.

Less growing space

Because the roots are in the growing media or water which have direct access to all the nutrients, there is no competition between the different plants for nutrition.

The result is that plants can be much closer to each other than in traditional farming methods. Done properly, you can, therefore, produce more plants per square foot than traditional soil farming.

This is what allows you to create a small but productive aquaponics system in your backyard or wherever you like!

Provides two sources of food

Considering this type of farming can provide an increased yield compared to traditional methods, a further bonus is the fact that you can get two food sources from one system. As the plants grow and flourish, you will be able to harvest the fish and eat them.

Continuous production

As you become more familiar with aquaponics, you may adapt your system and have plants in various stages of growth. Essentially, you can create a continuous supply of food by having several grow beds and starting your plants in succession, creating a never-ending harvest. Yes, you can do this too with traditional farming, but with aquaponics, it is much easier.

Aquaponics means that there is water flowing to the plants all the time. This gives them all the water they need. You don’t need to concern yourself with watering schedules. You need to top up the water level occasionally because the plants use the water, and it will evaporate. You can use an automatic top-up system that uses a float switch.

These are many of the reasons why aquaponics is so successful and growing in popularity; you can grow almost anything with very little effort.

Sustainability

The fact that you use less water and can produce more plants in less space and less time makes an aquaponics system a viable option.

The system is practically self-sustaining. Your main role will be to:

•Monitor the temperature and pH

- Feed the fish
- Drain the solids filter(s)
- Harvest produce and fish

Environmental Impact

Aquaponics is a viable option for the provision of food in the modern world where land and resources are becoming increasingly scarce. This is especially true in the developed world where land is needed for residential purposes.

Alongside this, there is an increase in consumer demand for fish, which cannot be supported by traditional fish farms. Unfortunately, this method of producing fish results in the release of toxic chemicals into the water at high quantities.

If you search for the following documentary on YouTube, you will have an idea about the problem we are facing.

But that is not the only issue with traditional farming methods. You may be surprised to learn that it can take 13 gallons of water to produce one lettuce in a soil-grown environment.

Using aquaponics, the same lettuce can be produced with 1.3 gallons of water; that's just 10% of the original water input!

In addition, aquaponics uses approximately ¼ of the space that traditional farming methods used to produce the same amount of food. The controlled environment of aquaponics can also help to ensure that crops grow faster. In fact, they can reach maturity in a little more than half the time of a traditional method (4-6 weeks in aquaponics for lettuce).

It is also important to consider the effects of pesticides that are commonly used in traditional farming methods.

These pesticides will help the crops get rid of pests. They also soak through into the soil and eventually end up in the rivers, the water supply and the food you are eating. These fertilizers can genetically modify, or even worse, kill other animals.

Pesticides are filtered out at a water treatment plant, but it still could end up in the groundwater.

This isn't an option when using aquaponics; any chemical pesticide would kill the fish and bacteria in the system. Not only is aquaponics a better option for the environment, it is also an excellent system to ensure that you can't cheat. The plants are completely organic.

The environmental benefits are clear, but this is not the only thing you need to be aware of when choosing an aquaponics system.

You can decide to have the installation inside a greenhouse, which will protect your crops from any fertilizers and pesticides which are sprayed nearby, so the wind cannot carry them onto your plants.

It is also much easier to manage the temperature and other variables when you are growing in an enclosed space. It also means that you can keep growing throughout the year, no matter how the weather is outside.

It is also interesting to note that an aquaponic system can be created virtually anywhere. In effect, you can make the food where it is needed, effectively reducing the ‘gas miles;’ and the amount of pollution that is being put into the atmosphere.

Let’s dive deeper into the technology that makes aquaponics special.

Chapter 2: Aquaponics Gardening Benefits

Aquaponics gardening is a sustainable type of raising food like plants and fishes.

Environmentally Friendly

The way aquaponics gardens works, they are able to recycle materials within their system. In essence, the natural wastes from the fishes are possible water pollutants. But because of the presence of microbes and plants, the water will remain clear and habitable for the fishes and other aquatic life. The plants filter the water, removing the waste and use them as food. The clean water is returned back into the garden. This essentially keeps the garden clean and fresh at all times.

Because of this basic setup, an aquaponics system does not require fertilizers or any chemicals. Furthermore, the entire system does not cause pollution to the environment and the produce is free from any harmful toxins and chemical residues.

Water Conservation

At first glance, an aquaponics system looks as if it uses too much water, maybe because of the large tanks that are used. The system actually uses much less water compared to conventional farming methods. Water from the tanks is continuously recycled. Waste-laden water from the fish tanks are brought o the plant bins for filtering, then returned clean and fresh for the fish. So basically, water placed at setup is the same water used for the rest of the operation. From time to time, you will need to add more water to account for evaporation, but the additions are considerably minimal and done much less frequently. More water is conserved if water used is from collected rain water. This way, the system does not contribute to water consumption and wastage problem.

Because of this, the aquaponics system can be used even in environments that are experiencing droughts. It is more like having a small oasis in the middle of a desert. All the water in the system is efficiently used and reused, reducing the need for huge water inputs on a regular basis.

More Yields

Aquaponics gardeners report higher yields in less time compared to

conventional gardening methods. Vegetables grown in aquaponics systems tend to grow larger, about 3 to 4 times denser than average. Plants grow and bear fruit faster than average, without using up all the nutrients in the system. This is because there is a steady supply of nutrients from the waste conversion happening in the fish waste and the microbes. In comparison, plants growing in the soil deplete the nutrients with each planting season. That is why most farmers are forced to augment soil nutrients with chemicals and fertilizers. Adding mulch can only add very small amounts of nutrients that are immediately used up. Another alternative is to rest the soil (no planting) for at least a season to allow the soil to recover.

Space Saver

Farmlands need to be expansive in order to generate a considerable yield. This is not just any kind of land. The soil has to be fertile. There has to be a good and steady access to water, good drainage system and ample sunlight, among other considerations.

These are not factors when using aquaponics. The system does not need soil.

100% Chemical Free

The most attractive benefit is most probably its 100% organic growing methods. Even the fish can be certified organically raised. First, pesticides, insecticides and other chemicals commonly used on plants are highly discouraged. These chemicals are potentially harmful to the fishes. Even the “organic pesticides” can harm the fishes. Hence, there is no cheating when it comes to aquaponics.

Weed- and Pest-Free

Weeding is a backbreaking task necessary in soil cultivation. Pests are also a problem with soil gardening. Hand-picking worms and bugs is also too much work. Other non-chemical solutions to weed and pest problems can only do so much. For those who do not have the time or energy, herbicides, pesticides, insecticides and other chemicals are applied to kill the weeds and pests. These products leave harmful residue on the plants and pollute the soil.

With the aquaponics system, tilling, compost shredding, fertilizing, chemical sprays and all the other hard work are no longer required. No bending down, either. All work is done standing up. There is no weeding needed. Work needed with aquaponics s as simple as fixing the electricity, giving fish food, adding seeds and fixing the potting media.

Chapter 3: Types of Aquaponics Systems

The three most important decisions that you need to make before you decide which system is going to work best for you is to:

1. Decide which system is going to work best for you?

2. Obtain all of the necessary components required to construct the system, and

3. Put it all together!

Every single aquaponics system needs the following to be effective:

- An aquarium, tank or pond for the fish.
- A grow bed for the plants.
- A means of transporting water both to the plants and the fish and back again (a recirculating system). Most people find that a pump of some description works best.
- A means of draining the water from the grow bed back to the aquarium, tank or pond where the fish are, siphon type pipes are often used to serve this purpose.

There are three main different types of aquaponics systems: Deep Water Culture (DWC), Nutrient Film Bed (NFT), and Media Bed. While these are certainly not the only aquaponics systems available, they are the three that we are going to focus on because they are the most common.

A Typical Aquaponic System

Before beginning with your design or deciding on what system you are planning on using, it is important that you consider the end use of your system and ask several questions that can help you make the best decision possible.

Are you planning on only building your system as a means of supporting your household with some additional organic vegetables all year round? Are you planning on considering a commercial venture with a much larger farm that will grow a large variety of different crops? Are you planning on using your system for educational purposes? Whatever your chief use is going to be, there are a number of other considerations that you need to consider:

These are as follows:

●What is your environment like? Do your seasons fluctuate radically between heat and cold? If this is the case, would it be better for you to consider your system inside versus outside, or in a greenhouse environment where it can be protected by some of the natural elements?

● How much space do you have available to you? This will also directly impact your decision on how much you will be able to produce and where. There is no point in looking to begin a commercial venture, when you live in a small 2-bedroom tenement building (unless you convince the landlord to allow you to convert and utilize the entire roof area, which could then provide food year round for all the tenants).

● What are you planning on growing—as a sidebar, there really is no point growing fruits or vegetables that you do not eat. This will naturally be a waste. It is the same as stocking the fish that you do not find palatable to the taste. All that will happen is that these will go to waste and that is the complete contradiction to this type of sustainable farming.

● Consider the different technical capacity and capabilities that you have. Some systems are pretty straightforward to put together and you would be able to manage on your own, while others require a slightly more professional approach. Make sure that you understand how your system works, what can go wrong, how to correct it if it does go wrong and how to maintain the system. Remember that when your system is faulty your fish and your crop are at risk. Initial close monitoring of a number of factors are

important to the success of whatever system you choose to use.

Deep Water Culture (DWC):

Deep Water Culture Aquaponics, also known as (DWC):

Closely modeled after the same principles that the ancient Aztecs and Chinese cultures used, this method is really just a modernized version. As the saying goes, “if it isn’t broke, don’t try and fix it!” This method has been used for hundreds of years successfully, so it has been a natural progression to duplicate this method today with a couple of modern tweaks. This method of aquaponics is really low maintenance and is best suited for fruits, vegetables and herbs that grow rapidly.

Examples of these would include leafy greens and lettuce. The setup costs for this system are also reasonable, so you won’t break the bank if you decide that this addictive hobby is not for you.

Once you understand how a deep-water culture design works, you will find it easy to adapt and design your own system that will meet the demands of your crops, your fish, your water, your pH and temperatures. Being able to monitor these will literally provide you with all that you need to run a successful aquaponics system.

Understanding that the DWC is very similar to the other systems, in that they still need to be monitored to make sure that both the fish and the plants are healthy and that the main ingredient, bacteria cycling, is necessary before starting your system. In any aquaponic system, the crucial ingredient to the success of the system is that the bacteria colony needs to be established before you “cycle” or let your system “go live”.

In a DWC system the roots of the plants remain submerged all the time or are mostly submerged all the time. Unlike hydroponics where premix nutrients are added to meet the needs of the plants being cultivated, here, the bacteria, fish, pH, water temperature and air temperature factor into the growing cycle and are the only things that need to be monitored closely for the first month that the system is up and running.

While some people use lightweight pots for their plants, the pots of choice are called net pots and are a popular choice for this method.

DWC is also an extremely popular choice for hydroponics. Although the main difference in using it with aquaponics is that you don't need to include grow media. The simplicity of this system is that the floatation device or beds are literally on top of where the fish are and there should be some form of aeration system included.

The design variations are only limited by how far your imagination can stretch, so grab your pen and paper and start thinking about the following:

●How much space do I have available?

● What crops am I planning on cultivating and how will this impact my system?

●With the crops I would like to cultivate, which fish are closely aligned to the temperatures and pH required to sustain optimal growth?

●What is my budget?

Once you have all the answers to the above questions, the next thing would be to physically measure out your system according to your plan. Remember that your system is a recirculating system and so all plumbing components need to be able to move the water between the plants floating in the net pots and back to the fish.

Deep Water Culture System

Remember to monitor your water temperature and pH levels constantly. These need to be in range to match the fish that you have stocked, as well as the plants that you are growing. Also make sure that your nitrification process is happening correctly.

Check all of your filters, pumps and piping on a regular basis to make sure that there are no blockages so that your water flow is not restricted in any way.

If you are planning on adding any plants to the fish tank, make sure that these are easy to maintain and aren't likely to cause disease for your fish.

Because this system is relatively easy to setup, with costs that can be controlled on the basis of your design, it is ideal for someone who is first

starting out with Aquaponics.

Flood and Drain or Ebb and Flow System

This system is by far the most popular system for beginners because it is easy to build and results in fairly good yields for someone who is just starting out.

This system works as follows:

•The plants or grow beds are situated above the aquarium, allowing drainage to take place naturally via the force of gravitation.

•Typically, plants would be planted in a grow medium such as clay pebbles. These will support the roots of the plant and will substitute soil.

•Water from the aquarium or fish tank is pumped into the grow beds by means of a submersible pump.

•The amount of water being pumped into the grow bed is usually monitored with a timer that is turned on and off. This allows for initial flooding and then draining back into the fish tank.

•An automatic timer is placed to control the flood and drain cycle. This makes use of a bell siphon, which means that it operates without electricity.

•The average timing for flooding would be around fifteen minutes per cycle, with a drain cycle of forty-five minutes.

Nutrient Film Technique (NFT):

While this system is very similar to the DWC method, the difference between the two is that the roots of the plants are watered by a steady flow of water in much smaller volumes. This is why they call it the ‘film’ technique.

The nutrient filled water virtually only moistens the plants root system, but it is constant.

Again, each of the plants sit in net pots in each of the channels or closed recirculating systems while the roots are fed as the water containing all of the nutrients passes by the bottom of the plants, also known as the root zone.

Just like the DWC method, there is constant flow between the different

components.

The water from the fish tank, pond, or aquarium is pumped into the NFT channel, where the roots are lightly covered, and this water then returns to the fish tank. With each of these systems a separate biofilter is needed.

NFT is one of the best choices when it comes to larger commercial farming. If you are planning on starting out with aquaponics for the first time—the Ebb and Flow system is better suited.

Chapter 4: Aquaponics system maintenance checklist

Aquaponics systems, unlike other growing systems, require less maintenance, but that does not eject the fact that it still needs to be adequately checked in successive intervals: monthly, weekly, and even daily if it is maximum performance is to be achieved. Some important points to note in maintaining an aquaponics system will be examined subsequently.

Verify the level and quality of the water

Make sure you have read or at least have a fundamental knowledge of the types of water before you fill your system so that you don't put in some bacteria and parasites that you will later regret. If you've poured portable water into your system or you used AG water and chlorinated it yourself, you must operate the system for at least a full day with the rafts off the troughs, but make sure the blower and the water pump is on so that you can remove the chlorine from the water. You have to be sure that your chlorine testing strip reads 0%, but it always takes longer than a day it might take as far as three days.

Furthermore, if you are using anything asides chlorinated potable water to fill your system up, there is a high tendency that something unwanted will go in with it. If you have this kind of water, its better you chlorinate it with a quart of Clorox per 600 gallons of system water. Fill the system with any type of water you have, calculate how much Clorox is needed to get that quart per 600 gallons, add it into the water. Turn on your pump and your blower, keep the system running that way for three to four days, if the rafts are not on the through, every living thing in the system should be dead at the end of the first hour or two. It’s essential you note this, do not overlook it, or else you might have yourself to blame. With all the living organisms in the water dead, the chlorine in the water will wear off in two days; it is after then that the next step can be done.

However, check your ph. before filling up. If you are using slightly acidic water, you can balance it up until it has a ph. of 7 by adding carbonate of calcium. If the water you are using is ordinary, you might have to add something to it that will add to its ph. level. We'll strongly suggest that you use acetic vinegar for that. If you want to get the ph. level down, you should get fish into the system; they breathe out carbon dioxide, which will turn to carbonic acid, which will ultimately acidify the water.

If you would have to add water to the system later, all you have to do is carefully follow the earlier stated techniques. If you are not careful enough to chlorinate the water, the chlorination will kill everything again. You should get a makeup water tank, fill it with water and chlorinate it, and then pump or siphon that water into your aquaponics system when the chlorine measures zero.

Put More fish in to get Fertilizers

Almost everyone starts their systems with fish. Although, some "experts" recommend "fishless cycling," most people don't even consider it because starting with fish work so well. The good news is that your system will startup even if you do nothing; the nitrifying bacteria that powers the aquaponics system will just work in a seemingly natural process in your system and start replicating until there's a balanced population. Unfortunately, the major problem is that it takes time! Sometimes, it can take up to three weeks for this natural process of replication to complete. The occurrence of nitrifying bacteria is somewhat natural as by reproduce asexually. If given time, they can reproduce very fast, so this is an excellent process only that it will cost you three weeks of untiring patience and optimism.

The proper amount of Fish

It is highly recommended that you operate with 0.3 pounds of fish per square foot of the raft area in your system. The trough area is used as a guide because the fishes generate the fertilizers that serve as a manure for the plants. Although it is not compulsory, you have that much to start.

The fact is, you may not even need this to start a good system. There was an incident where an aquaponics farmer wasn't able to get the "recommended" amount of replacement fish, he lost all his fish in an accident, and when he tried to replace them, he was only to get 7-pounds of 2-inch tilapia fish. This is ridiculously small compared to the recommended number, but the plants and vegetables still matured like magic! And the most surprising aspect is that he only feeds the fish twice because of his busy schedule.

This is what is referred to as the lower end. Although they had a small amount of Fish, the system still worked! These systems are balanced and always productive, but it still works if you don't get the recommended number of fish. However, we strongly recommend that you start your system with (at the most) 20% or so of the "recommended" amount of fish for your system. There are reasons for this: first, an attempt to buy a large amount of fish might be futile or herculean due to cost issues, and with the happenings we've observed, we've been able to deduce a system. That is supposed to have 80 fish will still work with 10 percent of that.

Secondly, at startup, you're trying to establish the nitrifying bacteria population in your system, the sensitivity of these bacteria to the ammonia of 3 ppm or over, and an excess of ammonia over three ppm is detrimental! It has what it takes to slow or even stop the startup process in its tracks.

Because the fish produce ammonia, a smaller quantity of fish that produces a smaller amount of ammonia is more preferable during startup. We'll also suggest that you do not feed your fish until the level of ammonia in your system comes down to 1 ppm, this helps you keep the ammonia level low and controllable.

Keeping Your Fish safe during hauling

If your hauling techniques are wrong, you'll end up killing your fish! Even if the place you get your fish from is close by, you'll still need to transport them into the aquaponic system. Unfortunately, hauling Fish stresses them and

even on the best and most careful fish hauls cases using haul tank with lots of aeration that has good oxygen levels even with 300 lbs. of fish in it, about 10 percent of the fish still died. Hence, if you have a terrible haul that stresses your fish or your fish supplier is not very careful the way he treats the fish, and you just go ahead to pick them up, you can lose up to 20% OR MORE!

Feed Your Fish

Your fish are pivotal and relevant to your aquaponics system, so they must stay fully nourished. Their feeding routine should be daily: once in the morning and again before sundown. And at worst they should be fed once a day. Although an automatic fish feeder can be used in case of your absence, it is more profitable to be around while feeding your fish to do a health check, because if you see that your fishes are not feeding properly, it may be a sign that something is wrong.

Check the Temperature of Your Fish Tank

It’s sacrosanct and vital that the correct water temperature is maintained in the fish tank(s) to create an ideal environment for the aquaponics fish species present. It’s a check that can be quickly done with ease just by searching on the perfect temperature for the type of fish you’ll be raising. The important aspect is that this must be done every day.

Check for Insects

It is better to solve an insect problem on time because it can quickly get out of hand. Whenever a plant is harvested, you should check for insects, which will usually reside beneath plant leaves or in the stem areas. Given its importance, this should be done weekly.

Check The ph. Levels

The ph. level in your aquaponics system is what determines the nutrients your plants will take in, the reproduction of the bacteria and how healthy your fish would be. It can be argued that the ph. level is the most important factor in determining how the aquaponics system works. Hence, it is vital that it be checked every week. The proper ph. level should be between 6.5 and 7.0, while some aquaponics systems steadily maintain this; over time, most system's ph. will decrease naturally. If it drops below 6.5, it's high time hydrated lime or potash is added to increase the ph. levels again.

Check the Ammonia Levels

Just like the ph. levels, another thing that dictates the health of your system is your Ammonia level. Ensure to inspect this every week to be able to detect any impending problem on-time. A good Ammonia level should be precisely 0.5ppm or slightly less. If it suddenly increases, it might be a pointer that a fish is dead.

Check the Nitrate Levels

Nitrates are usually very beneficial, but when they sky-rocket to detrimental levels (above 150ppm), this could mean that there are not enough plants to take in the nitrogen that’s being released by the nitrifying bacteria. Three things can be done to solve this: include more plants, harvest some fish, or add another grow bed to your aquaponics system. This check should be done every month.

Pumps & Plumbing System Check

All the pipes and plumbing must be inspected daily to ascertain that it's still functioning properly. However, monthly, the pipes and conduits should be cleaned. This may be somewhat dirty and stressful, but it is crucial to avoid blockages in the pipes.

Chapter 5: Best Plants To Use For Your Aquaponics Garden

Best plants

We can divide plants into two categories:

- Vegetative plants.
- Fruiting plants.

Vegetating plants are plants like lettuce, kale, spinach, and basil. Vegetative plants don't require many nutrients to grow. They can thrive with low nutrient levels. That's because vegetative plants require mostly nitrogen to grow.

Fruiting plants, on the other hand, need rich nutrient water to produce their fruits. Fruiting plants need nitrogen, phosphorus, and potassium to grow big fruit.

If you are familiar with hydroponics, you will know about the most important nutrients called N-P-K.

- N stand for nitrogen.
- P stands for phosphorous.
- K stands for potassium.

Nitrogen is needed for leaf growth, while more phosphorous and potassium are needed for fruit production. Because you will have plenty of nitrogen in the beginning (nitrates), it's easier to start growing leafy vegetables and move to fruiting crops later.

The nutrient potassium is supplemented into your system once the pH starts to drop (in combination with calcium). So, growing fruiting crops makes more sense when you have an established system where you already have supplemented potassium.

Your nitrate levels should go up and down all the time. If you have a healthy system and want to increase the available nutrients, you should increase fish

feed.

After you feed the fish, you should see a spike in ammonia, then nitrites, and then nitrates. The conversion from ammonia to nitrates can happen in a few hours. The faster this is completed while still maintaining optimal feeding rate (60-100grams/m²/day) in DWC, the healthier your system is.

Leafy Lettuce

This is one of the easiest plants to grow in a raft style system. The reason for this is the ease of access to nutrients, and they don't need support.

Lettuce

They are also tolerant of pH changes (between 6 and 7). Having their roots in oxygenated nutrient-rich liquid all the time is the perfect environment. It likes a temperature between 45 – 70°F (7-21°C).

Kale

Kale is very similar to leafy lettuce and can offer the same advantages to the dedicated grower. This is also a good grower because of access to water.

The fact that it tastes good and is full of vitamins is a bonus. Expect to harvest your first plants after 6 – 8 weeks. It likes temperature between 40 – 65°F (5 – 18°C)

Swiss Chard

Swiss chard is resistant to parasites and other diseases. With a little vigilance, you should have a grown crop in just a few weeks. You'll need to keep the temperature around 70°F to 85°F (25 – 30°C).

Basil

Basil flourishes in soil filled with water. Therefore, it will do well in a grow bed and in floating rafts. It can cope with drops in temperature, although it may slightly affect its growth rate. It likes 65 – 80°F (18 – 26°C)

It can be cut to harvest, and it will regrow again. It's best to cut a maximum of 3 times before using another basil plant. It's best to cut 6 inches from the

base of the plant and leave some leaves for its regeneration.

Watercress

This plant naturally grows in wet areas, so an aquaponics media bed or raft system will make it feel very comfortable. It is also a very fast grower; you'll be surprised at how quickly watercress grows.

Unless you keep it small, you'll be looking to give away or sell your crop. It'll be too much to eat yourself.

You should be able to start harvesting in just 3 – 4 weeks. It likes 60°F (15°C)

Bok Choi

This is a member of the cabbage family with a wide variety of names. As a cabbage, it will need a higher level of nutrients, and you'll need to maximize your fish stocking.

It is worth growing as it can be ready to eat in just 6 – 8 weeks. It likes temperatures ranging from 50 – 70°F (10 – 21°C).

Others

- Tomatoes.
- Peppers.
- Cauliflower.
- Broccoli.
- Beans.
- Peas.
- Cabbage.
- Cucumbers.
- Squash.

Most of these plants in this list have are top-heavy and, therefore, require a strong root system. That's why it's best to grow these in a grow bed or Dutch buckets where the roots and the media allows the plant to stay upright with the help of trellises.

You could grow these in floating rafts, but then you need to build sufficient support for them.

It's not unusual to see plants with big roots in a floating raft setup, but it's just less common.

Chapter 7: The Best Fish for Aquaponics and the Resolution of Fish Diseases

Finding the very best fish for your aquaponics system is dependent on a number of factors.

You need to consider the climate that you live in, what species of fish are actually either indigenous or common to the area, and whether you are going to settle for fish that are just decorative or whether you plan on eating them as a means of obtaining your source of protein.

This is one of the benefits of moving towards aquaponics rather than hydroponics.

Before you should even be considering which fish are going to work best for you, think about your needs and whether you are going to buy your fish from a hatchery, a local aquarium or online. Buying fish online is now in fairly high demand and so you will probably find someone in your area who delivers directly to your door.

A small sidebar here, if you are planning on ordering your fish online, please make sure that you are there to receive them, or someone else has access to receive them.

Please remember that they are live produce and will need to get into their respective tanks as a matter of urgency.

There is no right or wrong answer when it comes to purchasing your fish—some people prefer to go to the supplier, hatchery or aquarium and select the fish that they want themselves, while others are content to accept whatever they order online.

Some of the most successful fish for aquaponics include Angelfish, Bluegill or Sea Bream, Crappie, Goldfish, Guppies, Koi, Mollies, Sunfish, Swordfish, Tetras, Tilapia, and Pace.

Some of these are purely ornamental, while others can be reared for eating. The following fish are also widely used in aquaponics:

Barramundi, Carp, Catfish, Largemouth Bass, and Golden, Silver and Yellow Perch.

The main consideration is how well the species of fish will do within your own specific climate.

Angelfish

If you were considering using these beautifully colored fish in your tank for aquaponics, this would definitely be an option for the ornamental variety of fish.

They can be very pretty to look at and can have a calming effect over you while your plants are being nourished, however they are not suitable for consumption at all.

The Bluegill, also referred to as bream or sometimes even perch (which is incorrect), is a freshwater fish that can be found in North America.

It’s happy to live in either shallow or deep-water conditions, which makes it great for aquaponics.

If you are planning on stocking these, it may be worthwhile to add some tree stumps or other types of structures in your ponds as they enjoy hiding in this type of environment.

They would be great to stock for protein if you were situated in North America as they can grow to a reasonable size, ranging anywhere between 12 inches (30cm) long and approximately 4½ pounds (2.0 kg) in weight.

They are omnivorous and will pretty much eat anything, which is also important when it comes to aquaponics.

With Bluegill, you could even feed them scraps and they would be quite happy.

Crappies

There are a number of species that fall into the Crappies family. Crappies actually form part of the Sunfish family and are the biggest of the entire Panfish species. There are only two different types of crappies, white and black!

The White Crappie looks slightly different to the Black Crappie and although it grows to around the same size (6.7” to 20.9”), they weigh the same as the Black Crappie. While their coloring is much lighter and blotches that they have on their body often appear more like stripes, they also have only five or six dorsal fins, compared to the Black Crappie who have seven or eight. Counting the dorsal fins is actually the easiest way to tell these two apart, because while in the water, they can often appear to be exactly the same color.

Black Crappie

The length of Black crappies can vary between 5” and 19”.

The average weight is around 1⁄2 pound to a pound, although if they really get big, they could weigh in at 3 or 4 pounds. A black crappie is distinctive by its evenly spaced blotches that are located on the sides.

The white crappie is usually silvery green, while the black crappie is more olive colored.

Because crappies are extremely hardy fish, they are a great choice for starting out with aquaponics.

Ideal temperatures for crappies are between 70o-75oF, although they can still survive at temperatures as low as 55oF.

Goldfish

Goldfish make for amazing aquaponics fish, although remember that if you are going to choose to use Goldfish, these are usually just ornamental in nature and can obviously still produce hours of fun and enjoyment in being able to watch them while you unwind after a hard day’s work. Some further reasons for choosing to use Goldfish to support your aquaponics system is that they are extremely hardy.

They can survive in diverse water temperatures and so this doesn't become a case of having to double check water temperature or consider which side of the continent you are living on.

Another huge benefit of using Goldfish for your system is that they produce a lot of waste, which is exactly what your plants are going to need to thrive on.

Guppies

While guppies would probably be the last fish that you would consider to be suited to aquaponics, they are in fact very suitable.

There are a couple of reasons why they work really well for aquaponics—firstly they are really entertaining to watch because they dart backwards and forwards really quickly, and the second reason is that they are another resilient fish.

There are several factors that you need to get right before you can proceed with guppies. You must understand their different tolerances before you include them in your aquaponics tank.

Once you understand this, you can create the best conditions in your tank for success. While they are extremely hardy and resilient, they can take work to maintain and look after some other species and you need to do your research before taking the plunge.

I bet that you never knew that there are more than 40 different species of guppy out there, some of them being the Common Guppy or the Rainbow Fish. These are available worldwide and are usually a popular choice for aquariums and aquaponics systems; Ender Guppies are related to the common guppy but are green, red and silver in color.

They love a tranquil environment and warm water. One of the most important questions that are asked when it comes to guppies is whether they can be combined with other fish.

Koi

Next to Tilapia, Koi are the second most popular fish that aquaponics enthusiasts' stock as their fish of choice.

The main reason for this is because they are highly suited to aquaponics tanks and setups whether indoors or outdoors.

Koi live fairly long and breed in the system. This is because as a species, Koi are used to being kept in ponds or tanks as ornamental fish all their lives.

Not that you would ever guess, but Koi are related to both the Goldfish and Carp species. Being highly resistant to diseases and most parasites, they are ideal to be kept in close surroundings with other fish.

Because they are used to being in ponds, using Koi are best suited to an outdoor aquaponic environment.

You can even design your setup so that your Koi pond becomes the main feature in your garden. Because of their unique patterns and designs, watching Koi can prove to be both therapeutic and relaxing.

Mollies

Mollies are another ornamental fish that can be used for your aquaponics system. As you can see by the image, they are pretty and would be great to look at in an aquarium-based system.

It is not recommended for you to use them for any larger outdoor system where a lot of waste is needed, purely because they aren't able to produce the amount of by-product required to feed your plants sufficiently.

If you are only considering a smaller indoor system then they would be ideal and are recommended along with Goldfish and other ornamental fish.

Tilapia

Ask any aquaponics expert which the most popular fish is to use for their system, and they will more than likely answer 'Tilapia'. There are also many reasons why they are so widely used and popular. Some of the main reasons they work so well is because they are resilient and hardy, they can be an ideal fish to begin aquaponics with on a small scale until you are confident to move on to bigger things.

Another major plus is that they are actually quite friendly and will be friendly towards whoever feeds them. They also get on quite well with Catfish.

Tilapia are quite pleasant to the taste and grow big enough for a decent meal. They thrive in warmer water than other fish, opting for approximately 80o-86oF. They can survive fluctuating temperatures that range between 60o-95oF comfortably.

Channel Catfish

These are highly recommended for larger systems. Most people use these in areas where Tilapia is illegal. They are extremely well-suited to much cooler climates. If you live in an area where your winter is colder and you are running your system outdoors, these should be your fish of choice. Because they are accustomed to being in cooler water, you don't need to invest in water heaters to keep water temperatures constant, as you would do with Tilapia.

There are a couple of pointers when it comes to rearing Channel Catfish. Firstly, they like to live at the bottom of the tank.

It is important to know this so that you don't overstock your tank or try and raise them as this will cause them to get hurt.

It's not ideal to keep them in deeper or smaller tanks. A recommendation when working with Channel Catfish would be to raise them with other fish species that mainly use the top of the tank.

These would include fish such as Tilapia, Bluegill and Perch. Because they only live at the bottom of the tank, a much larger tank is recommended, i.e. in excess of 250+ gallon.

The ideal temperature for a Channel Catfish to survive and thrive is between 75o-80oF, although they can tolerate temperatures between 40°-90°F, making them also fairly flexible in nature.

Channel Catfish grow pretty quickly and can reach maximum sizes of between 40 – 50 pounds. Although they only need 32 – 38% protein.

Their feed conversion ratio is around 2:1 (2 pounds of feed to 1-pound size fish).

Catfish can be eaten and are rich in Vitamin D.

Before eating them though you need to skin them when preparing them for cooking.

Largemouth Bass

These fish are usually popular to North America and are known more as gamefish rather than a fish to stock for aquaponics.

Largemouth Bass are part of the freshwater fish family, making them ideal

for aquaponics.

They have a very wide temperature tolerance range, which means that they can be safely bred and reared through both winter and summer months quite safely.

Their temperature tolerance ranges between 50o–86oF, although their optimum temperature is around 68o–97oF.

The Largemouth Bass is carnivorous and needs more than 40% high protein diet. You can eat Largemouth Bass.

It has white flesh and is rich in omega-3 fatty acids. The bonus of eating this fish is that it is boneless (for those like me that can't stand picking bones out of fish).

Due to its size, the Largemouth Bass does require a much larger tank – the smallest that you will get away with will be around 1200 gallons.

Rainbow Trout

The Rainbow Trout belongs to the Salmon family and because of this, they are not only edible, but have a really pleasant taste. Trout thrive in colder water with average temperatures ranging between 57o–60oF and minimum temperatures for survival being 50o–64oF. Trout are also carnivorous and need up to 50% high protein diet.

You can expect rapid growth amongst your Trout, they are some of the fastest growing fish of all those used for aquaponics, adding between 800 to 1000 grams every 14 to 16 months. Rainbow Trout are better suited to colder climates because they don't survive in warm waters.

Trout need clean water to thrive, unlike Tilapia. They can be quite high maintenance because you need to ensure that their water is well oxygenated at all times and that the dissolved oxygen level never drops below 5.5ppm.

Trout also like to jump, so a covering of some description on your tank is going to be a necessity. While you may have your heart set on rearing Rainbow Trout for their specific taste and flavor, the climate that they survive in leaves you only a limited variety of plants that you could grow.

Because they are carnivorous, they need to be fed commercial fish pellets, and smaller fish, flies, snails and even bloodworms.

Jade Perch

It stems from Australia and so is used to much warmer environments.

Some interesting facts about the Perch is that they are really placid and get on well with other species, making them an ideal option for aquaponic enthusiasts where the climate is right.

Additional bonuses are that they can be harvested within about a year and they are delicious to the taste.

Another fish that is high in healthy omega 3-fish oils.

The ideal temperatures for Perch would be between 70o–80oF. It’s worth mentioning that if temperatures drop below 65oF, the Perch will stop eating, could become inert and die.

As omnivores, they eat almost anything, but still need a medium protein diet. Another downside of Perch is that they won't breed while in captivity unless they are injected with a specific hormone to allow this to take place.

Being fairly peaceful, they get on well with other fish in an aquaponic system.

Even though they are resilient, they still need a fair amount of dissolved oxygen to survive.

These can easily be pumped into the tank using traditional stones and an aerator. The best pH for Perch is between 6.8 and 7.8.

Carp

This would be your “go to” fish if you were planning on setting up an aquaponics system in the UK and they are ideal for larger scale aquaponic farming.

Part of the reason for this is that they have a high tolerance level for both hot and cold temperatures and can therefore survive the UK winter as well as summer conditions quite comfortably.

Carp do favor warmer temperatures and therefore a greenhouse would be ideal for them because they grow better in warmer waters.

There are a large variety of different Carp available and while they all belong to the same species, the most important three to remember would be the

Common Carp, the Mirror Carp and Koi Carp.

How to Maintain Your System?

First of all, realize that most of the problems found in traditional gardens will be eliminated without the soil. Why do you think farmers rotated crops for so many years? This is especially true when it comes to growing vegetables.

Cutworms and slugs are disgusting. Period. No longer will you need to sprinkle diatomaceous earth over the soil to discourage mollusks. Fungal and bacterial diseases propagating in the soil will no longer be an issue. (It's helpful to put a paper collar around lettuce seedlings to keep caterpillars at bay, but with aquaponic gardening you don't have to worry about any of that.) Hallelujah!

Now you can stop rejoicing, although you have other things to worry about. Your aquaponic garden is a balancing act. You need a balance between the number of fish you stock, the surface area of your biofilter, and the number of plants you grow. Your success will be determined by how well you regulate that balance and maintain a healthy environment.

Think of your fish on one side of a playground teeter totter. Your plants are on the other. The beam between the two is your biofilter with its bacteria turning ammonia into nitrates. Too little surface area means not enough bacteria, which means not enough fertilizer to grow the plants, leading to ammonia toxicity, killing the fish. On the other hand, if you stock too many fish or feed them too much, your waste may not be handled by the biofilter in place and that can also cause ammonia toxicity. Too many plants and not enough fish means your fish may be fine, but your plants will not flourish. It's a living ecosystem and you're in charge.

Before you freak out, remember: you have measuring devices to keep things under control. You just have to know what your readings mean and how to use them to adjust your system.

Let's talk about three measurements:

•Nitrogen balance: Increased levels of ammonia or nitrite suggest you have a problem with your biofilter. You need increased surface area for culturing bacteria. If your nitrate level is low, you either have too many plants or not enough fish.

•Food balance: The food ratio for leafy vegetables is 40-50 g/m2/day. Fruiting vegetables, like tomatoes require 50-80 g/m2/day.

•Health assessments: Each day as you feed your fish and monitor your system, look for the telltale signs of disease. Dead fish or plants are symptoms of a system out of whack.

One of the issues you need to safeguard against is mold. Let's talk about what mold is and is not. The white calcification you sometimes see on your growth bed is not mold. Green strands are algae, not mold. Look up methods to prevent algae formation in the glossary, because this could be a killer for your system as well, though it won't kill your plants or spread the same way as mold.

Mold is an opportunistic pathogen grown from spores. One type is a powdery mildew that will appear on your leaves as white spots. A more serious problem is white mold, which looks fuzzy and can grow to alarming proportions if left unchecked. At first detection, it may look like a harmless speck of white fluff, but it can turn into cankers and destroy the roots of your plant.

Mold develops because of contamination. A spore is introduced into your system. The warm, moist conditions prove favorable to its growth, until it overwhelms your system. Keep a well-ventilated system in place for moving air and don't let stagnant water sit in your trays.

Remove infected leaves immediately. You can wash them off with hydrogen peroxide to help prevent the spread. You can also introduce beneficial bacteria like Bacillus A. One way to eliminate mold is the use of a fungicide. The Serenade garden mold control spray is a broad-spectrum fungicide.

Mold isn't the only thing that will kill your plants, however. There are also a host of pests that may attack your plants. You have an advantage if you grow your plants indoors, but insects always seem to find a way to your garden. Your first defense is a healthy plant. An unstressed plant has high levels of phosphorus in its cells, and that repels some insects. But realize ahead of time that you are putting together an artificial system, and it is vulnerable to damage from insects.

One healthy way to rid your garden of unwanted insects is to capture them using a pheromone trap. They are specific to the insect, so one kind of trap

will not fix all kinds of problems. Think of it as a glue trap collecting unwanted guests, only this trap actually attracts them. Be careful in its use. You will need to keep them away from children and pets, and you will need to wash your hands after using them. If the trap is made for outdoor use, don't try to use it indoors. Read all of the product labels before trying to use one.

Another way is to manually remove offending pests. The cabbage white fly lives on the back of leaves. Picking them off will help reduce populations, because they produce 10 to 12 generations a year. You can feed them to your fish, who love a good, high-protein morsel. You can also drop them into a jar of soapy water and flush them away. The key is removing them immediately before they have a chance to reproduce. Another organic spray is BotaniGuard. For whiteflies, spray it directly on the plants or under the leaves. For aphids, spray it into the grow medium. It may take multiple applications to eliminate your pests, and you can use it weekly afterwards to prevent further problems.

Thrips are tiny insects that both suck out plant juices from the leaves, but also carry plant viruses. About as big as a sewing needle is wide, these are hard to see. This will be a bigger issue if your garden is out of doors, as the mature insect winters in plant debris and bark. It lays it eggs in early spring, and can produce up to fifteen generations per year. Thrips will look like little slivers unless you use a magnifying glass, and then be prepared for the shock of seeing a little animal with arms and pincers dining on your leaves. You'll more easily spot their damage in silvery and white speckles on plant leaves. Left untreated, you'll more likely see a virus causing some kind of wilting on your mature plants. You can shake them off, but that may not be aggressive enough if you're looking at an infestation.

If your aquaponic garden is outside, get rid of weeds and vegetation that provide a place for them to live. Introduce beneficial insects into your garden, things like pirate bugs, ladybugs or lacewing. Watch your plants and remove diseased leaves. You can use sticky traps to catch them manually. Since you can't employ an insecticide without affecting your fish, consider using a safe product like neem oil to treat them.

Chapter 8: Tips and Tricks For A Successful Aquaponics Garden

There is a lot of information to take in before you can get your aquaponics system successfully up and running. Therefore, it is important to follow the steps described earlier and use patience. Once you've established a system, you'll be able to modify your approach, materials, and technique to grow virtually any plant and breed any fish.

Here are some great tips to make your aquaponics system is a success.

Temperature

When you're first starting out, it can be difficult to maintain the temperature at the same time as you manage all the other elements of your setup. Therefore, it is advisable to choose fish that are comfortable in the average temperature where you live.

It is much easier to heat up water than to cool it down. It may be preferable to buy fish that prefer warm water and purchase a water heater to help maintain the temperature instead of pouring ice in your fish tank.

If you live in a cold area and want to have warm water fish with a floating raft system, you should insulate the bottom of your floating raft with insulation panels.

In the following illustration, you will see a floating raft setup with added insulation. Insulation can be added all around the troughs but is the most effective at the bottom.

Separate the Fish
Baby fish (fingerlings) must be kept separate from adult fish. If you don't, they are likely to be eaten by them.

This is important if you are breeding or restocking fish. However, you should separate the fish into another tank but still have it connected to the aquaponics system. Every bit of fish waste can help your plants flourish.

Warm-blooded animals in aquaponics

Never use any warm-blooded animal like ducks in your aquaponics system. Not even their manure. They will introduce the bacteria called E. Coli into your system, which can make you sick. The fish are coldblooded, so they are not a problem.

The Overflow

Build an overflow from your grow bed to the fish tank. This will provide you with a warning that something is wrong. You can even connect it to a sensor to ensure you are aware of the problem.

Clean your grow beds

If you measure high pH and ammonia levels even after you stopped feeding the fish for a while, you need to check your grow beds.
Rotten organic material will create zones that are deprived of oxygen. This means that the bacteria will die in that part of the grow bed. Which will harm the nitrification process. Resulting in lower available BSA, higher pH, and elevated ammonia levels.

Having one or more dead fish in your system increases the level of ammonia.

Electrical Protection

Your aquaponics setup relies on electricity to run the pump, lights, and sometimes to keep the water warm. You need to consider the likelihood of a power failure and what back-up system you can have in place, such as battery-operated pumps or even solar power to top up the batteries.

If you have a bigger system, it's not a bad idea to have a small bilge pump that pumps the water around the system once the power goes out. To make this, you will need:

- 12V Battery.
- Charge controller.
- Battery charger or solar panel.
- 12V bilge pump.
- Detection device for when the power is out.

Plug the power loss detector in the plug and wire up the bilge pump to the 12V battery. Once the power loss detector senses that the power is out, the bilge pump will start to pump. Murray Hallam has an excellent video about this on his YouTube channel called: "aphids, murray cod and backups."

You should, of course, ensure that all your electrical equipment is as far away from the water as possible; unless it is approved to go in the water. An electric shock is just as dangerous to your fish as it is to you.

Start small

It is essential to start your system small. This will allow you to make mistakes and learn from them without costing you a fortune and losing your fish. You can even set up more than one system at the start and combine them later.

Once you've established a successful small system, you can move on to a larger setup.

Chemicals

Don't forget that the chemicals you usually use on plants may not be safe in

an aquaponics system. Anything you add to the system will affect both the plants and the fish. You can only use natural products.

Don’t lose curious fish

There is a simple solution to this. Use a net to cover the pump or use a net pot and attach it to the pump’s inlet. That way, curious fish can’t go in the inlet and become instant sushi.

Make sure the pump inlet is free of any debris. If not, it will have reduced suction, which will lead to damage inside the pump.

Adding redworms

Redworms are very cheap to buy or cultivate yourself. They have been shown to be effective at reducing waste build-up in grow beds. They won’t drown in your grow beds as long as you use flood and drain.

They will eat the solids that are inside your beds. They excrete usable nutrients for the plant to use (mineralization). If you have enough red worms, you may only need to clean your grow bed once every five years.

A few red worms

Root rot

If your roots start to rot, then you’re going to have plants die. Therefore, it is essential to pick it up as soon as possible and resolve the issue. Root rot occurs when your roots don’t get enough oxygen or when you have bad solids filtration.

You need to make sure there is plenty of oxygen in your system (min 5ppm).

You can check for root rot by looking at the roots of your plants. If it is slimy and has a brown color, then you know that your roots aren’t doing well. Ideally, the roots of the plant need to be white.

Chapter 9: Common Problems to Avoid

Establishing an aquaponics system takes time, patience, knowledge, and most importantly, trial and error.

Being aware of the most common mistakes will make it easier for you to avoid making these and build a successful system.

Access to The Fish

You'll notice some fish tanks are designed with the grow beds on top of the fish tanks. This can save on pipework but will not help you access your fish. The same can be said if you build the fish tank in a location that is difficult to access.

If you can't get into the fish tank, you can't check when a fish is ill, and there will be no space to do some plumbing. This can cause a serious issue if you need to act quickly and can't get into your tank. You must consider access before you start setting up your system.

Iron deficiency

This is one element that is often overlooked but is essential to the health of your plants and their ability to do photosynthesis. Iron is needed in a plant to produce chlorophyll, which results in green leaves. If there is an iron deficiency, the leaves will start to become yellow. The deficiency is called chlorosis.

It is advisable to purchase an iron test to check the iron levels at least once a month.

If iron levels are low (1.5 to 2ppm), you can add some with a chelated iron supplement (to 3ppm) that can be bought online or in a hydroponics store. You can spot iron deficiency if the leaves are turning yellow instead of green while the veins are still green. It will show up on the new leaves (top of the plant).

Iron will become less available to the plant if the pH is higher than 6.5. That's another reason why you need to keep your pH between 6.5 and 7.5.

Potassium deficiency

Potassium is needed by the plant to regulate its water uptake.
Potassium is provided by the fish food but is barely enough to run the system because fish need potassium too. A deficiency in potassium will lead to reduced resistance to pests, unhealthy roots, and smaller fruits.

The symptoms of potassium deficiency are scorching and burning leaf tips and yellowing of the leaf between the veins. This deficiency is most common in fruiting plants. Symptoms will show on the lower leaves first because they were the first to grow (oldest growth first).

Do not confuse potassium deficiency with nitrate or iron deficiency. You can test nitrate deficiency with a simple test kit, and you can rule out iron deficiency to look at the place the yellowing leaves occur. If the yellowing occurs in the lower leaves, it's potassium deficiency. If it occurs in new leaf growth, it's iron deficiency.

When your pH is low, you will be supplementing with a 50/50 mix of potassium hydroxide and hydrated lime.The hydrated lime (calcium) will raise the pH, but the potassium hydroxide will avoid that calcium takes the upper hand.

When you don't need to lower your pH but have a potassium deficiency, you need to supplement potassium that is pH neutral. One of these supplements is kelp or kelp meal. You can spray it on the leaves or supplement it in the water.
If you have a large deficiency, consider using potassium sulfate dissolved in the water of the system. It's much stronger than kelp or kelp meal. The amount depends on the volume of the system and the strength of the solution.

pH Issue

If your pH levels are off (6.5 to 7.5 is good), it is important to adjust them to ensure your fish and plants are comfortable. However, this is something that must be done gradually. You should not drop or raise the pH by more than .5 per day. If you do, you're likely to put the fish under stress; that's not a good plan as stress will reduce their slime layer, which is protecting them from diseases.

Algae

It is worth talking a little more about algae. In the long run, the level of algae should stabilize, but when you're first getting started, it can be a real pain.

Green algae are the most common issue in aquaponics. Too much of it is likely to make your water appear green and can even block your pipes and filters in extreme cases.

But this is only part of the problem! Algae can also accumulate in your grow beds and steal the oxygen that is vital to your system.

It can also affect the pH of your system. It can cause the pH to swing in both directions. It can make remedial action difficult, especially if you're new to aquaponics. It is best to watch the pH for a day or two before reacting. If it's low in the morning but high late in the afternoon, you probably have an algae problem.

To control the algae, you'll need to add shade to your fish tank and exposed water. The lack of sunlight will stop the algae from reproducing.

It's important if you are planning to use grow beds, which the top layer that's exposed to the sun will not get wet. This is to discourage algae from growing in your grow beds. Place 1 inch of dry expanded clay or river rock on the top of your grow beds to block out sunlight.

It is also possible to add organic humic acid. It's an organic darkening agent. It will darken the water, preventing the algae from getting the light they need to grow.

If you are running a DWC system, you can add shrimps under your floating rafts. They eat the algae and other organic matter that will be in your troughs. You should supply them with some objects to hide from each other because they are territorial. You can use the leftovers of your building materials like piping scraps.

Leaving the system to do its work

Once you've got the system working and the fish are doing well while the plants are growing, you need to continue to monitor them. One of the most

surprising and common issues is when people leave their systems completely alone if everything is running properly once the fish and the plants are happy. In theory, this is correct, but it is unlikely to be the case in practice.

An aquaponics system is generally less work than the traditional approach to gardening and crop growing. But you still need to monitor the system and make the appropriate changes. Forget this, and your system will have a problem; faster than you think.

Adding Water

The quality of the water going into your system must be excellent. Choose rainwater or water from an already successful aquaponics system when you are starting out.

Failing this, you need tap water. The pH should be between 6.5 and 7.5, and the temperature between 64 and 86 degrees (18° and 30°C). Depending on the tolerance of the fish, you have chosen to add to your tank.

If you are topping up your system with tap water, only top up a small amount. The chlorine or chloramine will kill some bacteria. If you put in a small percentage, you will be fine.

Grow Media

Many people are tempted to purchase a local option because it is cheaper (and that's a good thing). Whatever option you choose, it is essential to use one that is pH neutral and doesn't have limestone in it. This will ensure you have the perfect conditions for bacteria to multiply and your plants to grow.

Earthquakes

Luckily, this might not be applicable to you. If you live in an active area for earthquakes, you need to know there might be a tear forming in your piping or fish tank. In case of an earthquake, how little it can be, check for tears and leaks in your system.

Solid foundations

Having a solid foundation for your system is a must. I have seen so many great setups without a proper foundation. Once it rains or there is a leak in one of the pipes, the sand under the fish tank or growbeds erodes away, which will result in disaster.

Don’t be that person, place a solid foundation. Digging down and using cinder blocks or gravel to allow good drainage will put you in a good position.

Sumps

Sumps are used to create the lowest point in your system. From there, the water is pumped back to the fish tank. Because sumps are the lowest point in your system, they are partially or fully underground. If you live in an area where there is a lot of rainfall, the water table can rise and push the sump tank up or even crack it. This will lead to disaster.

Having your sump topped up to at least half (I recommend ¾), would alleviate this problem. The water in the IBC will have the same force of the groundwater surrounding it, so it doesn’t get pushed up or cracks.

Another recommendation about sumps is that it’s better to have the sump filled up as high as possible without causing any spills. Having a high-water level will result in less head height for your pump to deliver. Less head height means more flow and less energy usage.

Rootbound

Most of the time, rootbound appears in growbeds. Rootbound means there are too many roots in the growbed. The roots will block the siphon from doing its job. The roots will also decrease draining speed, which results in longer cycle times. Furthermore, solids will become trapped in the root mass, which will result in more anaerobic zones.

If roots become a problem in your growbeds, it’s best to remove them before your nitrifying bacteria die. Once your pH is starting to rise, you should check for problems in your growbed(s).

Cleaning out growbeds

Cleaning out growbeds is not a fun activity. That's why you would like to do them all in one go. But that might not be a good idea.

It's better to clean out one growbed at a time and wait a few weeks before cleaning out the next one. If you clean out the growbeds all at once, your bacteria population might suffer. If you do them one by one, your bacteria population will keep the nutrient supply stable.

Nitrite spike

The nitrite spike, also known as nitrite poisoning, is a problem that occurs when starting your system with adult fish before there are bacteria present.

Your system needs to populate two different kinds of bacteria to convert ammonia to nitrates. The first ones are called Nitrosomonas and convert the ammonia to nitrites. They colonize the system first and reproduce faster than the other bacteria. The other bacteria are called Nitrobacter, which converts the toxic nitrite to beneficial nitrate. These bacteria are slower in colonizing the system and slower to reproduce.

If you stock the fish without having the second bacteria (Nitrobacter) to convert nitrites to nitrates, you will have a spike in nitrites. This is very toxic to the fish and will lead to dying fish.

Not cleaning out your growbeds or cleaning out all your growbeds at one time can also result in nitrite poisoning.

Fish gasping for air or faster gill movement than usual, while the dissolved oxygen in the water is high, is an indication of nitrite poisoning.

MildewCide

If you decide to paint your system, make sure you are not using a paint that has the chemical mildewcide in it. It is used as mildew prevention on newly painted surfaces.

Once it comes in contact with your water, it will leech into the water and will make your fish and plans sick or even kill them.

Conclusion

From all you have learned from this book, I'm sure you can now see that aquaponics shows how well nature can relate together in the most unusual way. How a new type of ecosystem can be made between plants and animals.

I hope that with this book, you have gotten useful and viable information that will set you up for success in your next adventure in aquaponics. This approach will help you know what gardening can truly be used for and how much you can get from that little space behind your house.

Don't forget that it takes time and effort if you want to get the best from this system. And I know that as you commit yourself to this system, you would discover even more significant opportunities that will take you from your garden to a more extensive system of aquaponics agriculture.